6-1972

The Effect of the Number of Pigs Per Pen on the Performance of Growing-Finishing Swine

John Hodges III

University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by John Hodges III entitled "The Effect of the Number of Pigs Per Pen on the Performance of Growing-Finishing Swine." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Science.

Frank B. Masincupp, Major Professor

We have read this thesis and recommend its acceptance:

J.B. McLaren, J.A. Corrick

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

1p 3

March 8, 1972

To the Graduate Council:

I am submitting herewith a thesis written by John Hodges III entitled "The Effect of the Number of Pigs Per Pen on the Performance of Growing-Finishing Swine." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Frank B. Mascuppp
Major Professor

We have read this thesis
and recommend its acceptance:

J. B. McLaren

J. A. Cornick, Jr.

Accepted for the Council:

Hilton A. Smith
Vice Chancellor for
Graduate Studies and Research

THE EFFECT OF THE NUMBER OF PIGS PER PEN ON THE PERFORMANCE OF GROWING-FINISHING SWINE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

John Hodges III

June 1972

ACKNOWLEDGEMENTS

For their generous contributions of time and advice in assisting in the preparation of this thesis and in making his graduate study possible, the author wishes to express appreciation to the following persons:

Dr. F. B. Masincupp, Major Professor, for his sincere interest and advice in collecting data from the experiments and for his suggestions in presenting the factual data herein.

Dr. J. B. McLaren, Associate Professor, Animal Husbandry, for his assistance in collecting and analyzing data from the experiments, serving on the graduate committee and for reading the thesis.

Dr. J. A. Corrick, Assistant Professor, Animal Husbandry, for reading the thesis, serving on the graduate committee and other assistance during the graduate study.

Dr. C. S. Hobbs, former Department Head (deceased), for the opportunity to do graduate work and for his encouragement, friendship, and guidance throughout the study.

Mr. J. N. Odom, Superintendent of Knoxville Station, for his cooperation in use of the facilities and sound advice.

Dr. G. M. Merriman, Professor, Animal Husbandry, for his encouragement, friendship, and cooperation while in graduate school.

Mr. Jackie Martin, manager, and Mr. Mike Summey, swine worker, Blount Farm, whose unselfish efforts and patient cooperation have made this study possible.

Dr. S. A. Griffin, for his guidance, encouragement, and friendship.

Miss Shirley Thacker, for typing the thesis so efficiently and expertly.

Mr. and Mrs. John Hodges, Jr., parents, for their encouragement, advice and many sacrifices that made college study possible.

Mrs. Charlene Hodges, wife, for her encouragement and patient consideration throughout graduate school.

ABSTRACT

Data collected on 140 market hogs at the Knoxville Experiment Station, Knoxville, Tennessee, were used to determine the effect of the number of pigs per pen on performance of growing-finishing swine. In Trial I pigs were fed for an average of 108 days and in Trial II pigs were fed for an average of 91 days. In both trials pigs were fed in groups of 4, 6, 8, or 10 pigs per pen with space allowances of 23.8 square feet, 15.8 square feet, 11.9 square feet, or 9.5 square feet per pig, respectively.

Average daily gains in Trial I were 1.48, 1.52, 1.46, and 1.48 pounds per head per day for Treatments I, II, III, and IV, respectively. No significant difference between treatments (variation in floor space) was noted with respect to any traits measured (Trial I). However, significant ($P < 0.05$) differences were observed between barrows and gilts.

In Trial II, average daily gains were 1.71, 1.63, 1.63, and 1.62 pounds per head per day for Treatments I, II, III, and IV, respectively. Performance of the pigs by treatment in Trial II was not significantly different as were the results of Trial I. There was a significant ($P < 0.05$) difference in the performance of the pigs by sex and by weight groups; however, the overall results of Trial II were similar to that of Trial I.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

With the present trend toward more intensified swine production using confinement systems, much emphasis has been placed on floor space requirements per pig and/or number of pigs per pen. Recommendations range from 8 to 24 square feet per pig and from 4 to 40 pigs per pen depending on the weight of the pigs and the type of floor surface. Therefore, swine producers and feeders are using various combinations of these recommendations which leads to the possibility that their facilities are not being utilized to the best advantage. The deficiency of available information with respect to space requirements for finishing swine is apparent in Tennessee. Generally, Tennessee swine producers are utilizing research information collected under various other climatic and environmental conditions. In many incidences, these conditions are not comparable to Tennessee conditions.

The small margin of profit from a swine finishing operation makes maximum efficiency in facility and labor utilization a necessity. For this reason, the objective of this study was to determine the effect of feeding varying numbers of pigs per pen on rate of gain, feed efficiency and backfat thickness.

CHAPTER II

LITERATURE REVIEW

Two experiments were conducted by Clawson (1962) to determine the influence of the number of pigs fed per pen on growth and feed conversion. In the first study, conducted in winter, four groups of 15 pigs and four groups of 30 pigs were fed in pens of equal size. Open-front sheds, with a southern exposure, provided a total floor space of either 26 or 13 square feet per pig, one-half of which was under cover, were used to house the pigs. Pigs fed in groups of 30 (13 sq. ft. per head) consumed slightly more feed and gained slightly faster than those fed in groups of 15 (26 sq. ft. per head); however, these differences were not statistically significant. In the second study, four groups of 4, 6, or 8 pigs were assigned to pens of equal floor space in a summer experiment. The pens provided 21, 14, or 10.5 square feet of total floor space per pig, one-half of which was covered. Average daily gain was significantly influenced by space allotment but feed efficiency was not affected.

Space allotments of 5, 10, and 20 square feet per pig and 3, 6, and 12 pigs per pen were compared by Heitman et al. (1961) during the post-weaning finishing period. Pigs allowed 20 square feet gained significantly faster ($P < 0.01$) than those with only 5 or 10 square feet of floor space. The number of pigs per pen apparently had no effect on the rate of gain. Live backfat probes indicated that there were no significant differences in fatness due to the number of pigs

per pen or to the floor space available per pig when measured as either actual probe or probe corrected to a standard weight. Space allotment had no significant effect on daily feed consumption, but the pigs fed in groups of 3 consumed significantly more ($P < 0.05$) feed than those fed in groups of 6 and consumed significantly more ($P < 0.01$) feed than the groups of 12. The pigs fed in groups of 3 also required significantly more ($P < 0.05$) feed per unit of gain than the pigs provided 5 square feet of floor space.

In a winter trial, Noland et al. (1959) provided 8, 16, and 24 square feet per pig with 16, 12, and 8 pigs per pen, respectively. The pigs furnished 16 square feet of floor space per pig gained significantly ($P < 0.01$) faster than those provided only 8 square feet per pig. In this test the pigs allotted 16 square feet per pig made more efficient gains than those with either 8 or 24 square feet of floor space. The time required for the three groups to reach 125 pounds was similar regardless of space allotment or number of pigs per pen. In a summer trial, the pigs supplied 16 or 24 square feet of floor space gained more rapidly than the pigs supplied 8 square feet. For the three groups, the gains were 1.31, 1.34, and 1.23 pounds per head per day, respectively. The pigs provided 8 square feet of space were slightly more efficient (290 pounds of feed per cwt. gain) than those supplied 16 square feet (312 pounds of feed per cwt. gain) or 24 square feet (322 pounds of feed per cwt. gain).

In three separate trials, Burnside et al. (1969) studied various space allotments per pig using a double-decked, environment controlled Bacon Bin system cooled with eight air conditioners. In two of the

three trials, rate of gain was significantly ($P < 0.05$) faster for pigs allotted 0.55 square meters than for those allotted 0.41 square meters. There was no significant difference between the rate of gain of the groups allowed 0.82 and 0.55 square meters of floor space per pig.

Gehlbach et al. (1966) conducted four experiments involving 600 growing-finishing swine. Experiment one and two were conducted during the periods of July to November and April to July, respectively. From the initiation of the experiment until the pigs averaged 50 kg. in weight, space allowances were 0.18, 0.36, and 0.54 sq. m. per pig. From 50 to 70 kg. the space allotments were increased to 0.36, 0.54 and 0.72 sq. m., respectively, and during the final period, from 70 to 90 kg., each pig was given 0.54, 0.72, or 0.90 sq. m. of space. The pigs were fed in groups of 7 per pen and pen size was varied at each interval. In experiment three, groups of 8, 12, and 16 pigs were fed to an average weight of 45 kg. with a floor space allowance of 0.36 sq. m. per pig. From 45 to 90 kg. in weight the numbers of pigs per pen were reduced to 4, 6, and 8, respectively, to allow 0.72 sq. m. of floor space per pig. In experiments one and two, average daily gain of the pigs provided 0.18 sq. m. of floor space per head up to 50 kg. was significantly lower ($P < 0.01$) than for those provided 0.36 and 0.54 sq. m. of floor space. From 50 to 70 kg. and from 70 to 90 kg. the amount of floor space did not significantly affect gain in experiment one. However, rate of gain was significantly ($P < 0.01$) affected during both of the latter periods in experiment two. Feed efficiency was not significantly affected by space allowance in either of the experiments. In experiment three, during the period to 45 kg.

in body weight, the group with 16 pigs per pen gained significantly ($P < 0.01$) slower than the groups with either 8 or 12 pigs per pen. In experiment four, average daily gain was not significantly ($P > 0.05$) affected by variation in floor space; however, the combined results of the four experiments indicated that the 16-pig group gained at a slower rate than the 8- and 12-pig groups.

Three treatments consisting of one lot of 10 barrows and one lot of 10 gilts were allowed 0.28, 0.42, and 0.56 sq. m. per pig from 16 kg. to 45 kg. and 0.56, 0.84, and 1.12 sq. m. from 45 to 77 kg. of body weight were fed by Hugh and Reimer (1967). The barrows gained significantly ($P < 0.05$) faster than the gilts. No significant sex x floor space interaction existed; however, the data suggest that gilts require more space for maximum rate of gain than barrows. Maximum gain for gilts was obtained with 0.56 to 1.12 sq. m. per pig allowance, whereas barrows gain fastest with only 0.28 to 0.56 sq. m. allowance. A trend toward improved feed efficiency was indicated as floor space increased. For combined sexes, space allotment had no effect on daily feed consumption. However, daily feed intake tended to increase for barrows and decrease for gilts with increasing floor space allowance.

Bond and Peterson (1958) listed the following space requirements for 10 or more pigs per pen: pigs up to 100 pounds, 5 to 9 square feet of space per pig; 100-200 pounds, 8 to 15 square feet of space per pig; and 200-300 pounds, 11 to 22 square feet of space per pig. They also stated that space allowances per pig should be increased if there are fewer than 10 pigs per pen. For best performance the largest space

per pig was required when one pig was fed per pen. Their recommendations also called for increasing the space allowance in warm weather.

The Swine Housing and Equipment Handbook (1968) recommends 4 square feet of floor space per pig from weaning to 100 pounds, 6 square feet of space per pig from 100 pounds to 150 pounds, and 8 square feet of space from 150 pounds to market. They suggest that each finishing pen should not hold more than 20 pigs. Grouping of pigs in larger numbers generally resulted in a slight decrease in rate of gain, an increase in pigs social-behavior problems such as tail-biting and cannibalism and more variation in the size of pigs at market weight. Smaller grouping may increase production efficiency but will require more equipment.

Results of research conducted by Muehling (1969) suggested recommendations of 6 square feet of space per pig from weaning to 100 pounds, 8-1/2 square feet from 100 pounds to 150 pounds and 11-1/2 square feet from 150 to 210 pounds. He found that the type of roof did not affect floor-space requirement or pig performance and that minimum space requirements in confinement on solid floors, partially slotted floors or totally slotted floors was essentially the same. He recommended extra space be allowed when pigs were fed on solid floors so the pigs and pens could more easily be kept clean. He also found that the number of pigs per pen affected performance and he further observed that 16 pigs in an 8- by 16-foot pen appeared to have more room than 8 pigs in a 4- by 16-foot pen.

According to the National Hog Farmer (1968), space allotments per pig from weaning to 75 pounds should be 7 square feet during the

summer and 6 square feet during winter. From 75 pounds to 125 pounds, an allowance of 9 square feet in the summer and 8 square feet in the winter was indicated and from 125 pounds to market weight the allowance should be 12 square feet in the summer and 10 square feet in the winter.

Rea (1970) found no significant difference in average daily gain between one group of hogs fed 8 pigs per pen having 15 square feet per pig and another group fed with 12 pigs per pen having 10 square feet of floor space per pig up to 220 pounds.

According to Corrick (1968) in work with white male rats, the more crowded the animals the better were their gains. He fed 8 rats per pen which provided 107 square centimeters per animal, 4 rats per pen which provided 134 square centimeters per animal, and 2 rats per pen having 214 square centimeters per animal. The 8-rat group gained a total of 241 grams compared to 215 grams for the 4-rat group and 194 grams for the 2-rat group. He postulated that crowding meant more competition which lead to more interest in the feed which, in turn, lead to more feed consumption.

CHAPTER III

EXPERIMENTAL PROCEDURE

I. FACILITIES

The experimental animals were fed in pole-type barns open to the south side with the north side closed during the winter and open for ventilation during the summer. The pens were five feet wide and 20 feet long with an automatic waterer and one two-hole self feeder per pen, with the feeder being located under the roof and the waterer at the opposite end of the pen. The floor was solid concrete with a slight slope to the outside gutter to provide drainage. The pens were scraped daily with a 30-inch hand scraper. During the winter straw was used for bedding and during the summer sprinklers were used. The panels between the pens were one inch by six inches oak boards with a three inches to five inches opening between them to allow air circulation.

II. MANAGEMENT AND DATA COLLECTED

Following weaning, pigs from the U. T. Swine Herd at the Knoxville Station were allowed a two to three week adjustment period prior to the experimental period. They were self-fed the standard U. T. finishing ration as shown in Table I, in groups of one to two litters, during the adjustment period. The pigs, weighing from 60 to 80 pounds, were then divided on the basis of breed, sex, and weight

TABLE I

STANDARD U. T. 16% FINISHING RATION

Ingredient	Pounds
No. 2 yellow corn	751
Soybean oil meal (44%)	150
Tankage (50%)	50
Dehy. alf. meal (17%)	30
Dicalcium phosphate	10
Salt	5
Trace mineral premix[1]	1
Antibiotic[2]	1
Vitamin premix[3]	2
Total	1,000

[1]Provides an addition to the ration of 100 ppm of Mu, 1 ppm Co, 100 ppm Fe, 10 ppm Cu, and 100 ppm Zn.

[2]Contains 10 gm. chlorotetracycline per pound.

[3]Provides an addition to the ration of 2 gm. of riboflavin, 4 gm. pantothenic acid, 9 gm. niacin, 10 gm. choline, 10 mg. B_{12}, 500,000 I.U. vitamin A and 250,000 I.U. vitamin D.

into groups of 4, 6, 8, and 10 head. Initial weight was recorded and the pigs were weighed at 14-day intervals throughout the experiment. At the time the final weight was taken, all pigs were probed for backfat thickness. Daily feed records were also kept in order to determine feed efficiency and total feed required per head.

III. TRIAL I

Twenty-two Hampshire gilts, 23 Hampshire barrows, 22 Duroc gilts, and 16 Duroc barrows were fed at the Knoxville Experiment Station starting December 1, 1970, and the experiment was terminated March 22, 1971 (Trial I). Three replications of each of the four treatments (4, 6, 8, and 10 pigs per pen) were fed the standard 16% U. T. finishing ration (Table I) in 12 pens. Due to a known growth response gradient in the feeding barn, a randomized block design was utilized. Pigs of each breed-sex subgroup were randomly assigned to pens and treatments were randomly assigned to pens within blocks in Trial I.

Excess feed waste was observed in pen 5 during the experiment. The feed consumed was adjusted for this excess waste by various methods of estimating the magnitude. The final adjusted value of feed consumed for this pen was a conservative adjustment for the wastage and was equal to or greater than the feed consumption of the next highest pen value.

IV. TRIAL II

Trial II was started May 31, 1971 and terminated September 7, 1971 utilizing 46 Duroc gilts and 10 Duroc barrows. In Trial II, the pigs available for the comparison varied considerably in weight, so they

were divided into two groups (heavy and light weights) with each of the four treatments (4, 6, 8, and 10 pigs per pen) randomly assigned to pens within each weight group.

In both Trial I and Trial II the feeder, waterer and pens were the same size and arranged the same. In both trials the pigs on treatment one were provided 23.8 square feet per pig, those on treatment two were provided 15.8 square feet per pig, those on treatment three were provided 11.9 square feet per pig and those on treatment four were provided 9.5 square feet per pig.

V. STATISTICAL ANALYSIS

Disproportional subclass numbers necessitated the use of least-squares methods, described by Harvey (1960), which compensates for this disproportionality. Multiple range tests described by Kramer (1957) were used to separate mean differences when significance was indicated by the F test.

The following model was used to analyze these data.

$$l/_i = \mu + t_i + s_j + b_k + r_l + e_{ijk}$$

where μ

Y_{ijkl} = ADG, day on test or backfat probes

t_i is the effect peculiar to the i-th treatment

s_j is the effect peculiar to the j-th sex

b_k is the effect peculiar to the k-th breed

r_l is the effect peculiar to the l-th position in the barn

e_{ijkl} is a random, independent, element peculiar to each observation.

In Trial II, the element representing breed was deleted from the model and the element representing position in the barn (r_1) in Trial I was considered to represent differences due to groups of pigs of light and heavy initial weights in the second trial.

CHAPTER IV

RESULTS AND DISCUSSION

I. TRIAL I

A total of 84 market hogs were fed for an average of 108 days on one of the four following treatments: 4, 6, 8, and 10 pigs per pen repeated three times in a pen 5 feet wide by 20 feet long. One pig was removed toward the end of the feeding trial because of lameness. All treatments were fed the standard U. T. 16% ration (Table I, page 9). The overall average initial weight was 64 pounds, average final weight was 223 pounds, average daily gain was 1.48 pounds per head per day and average fat thickness was 1.08 inches. These means along with their standard errors are shown in Table II. These gains are comparable to those observed by Noland et al. (1959) and slightly higher than those reported by Heitman et al. (1961).

Means for various weights and fat thickness measurements are shown by breed in Table III. The Hampshire pigs were lighter in weight initially than the Durocs. These weights were 63 and 66 pounds, respectively, and the Hampshire pigs gained slightly faster, 1.51 pounds per head per day vs. 1.47 pounds per head per day, with an average fat thickness of 1.06 inches vs. 1.09 inches, respectively. There was no significant difference ($P > 0.05$) between the two breeds for the traits measured.

As was expected from previous comparisons (Hugh and Reimer, 1967), the barrows gained significantly faster ($P < 0.01$) than the

TABLE II

PERFORMANCE OF PIGS THAT WERE FED TOGETHER IN GROUPS OF 4, 6, 8, OR 10 IN THE SAME SIZE PEN (TRIAL I)

	Overall Means	Standard Error
Avg. wt. and gain, lb.		
Initial	64	12.12
Final	223	8.98
Total gain	158	12.21
ADG	1.48	0.16
Backfat thickness, in.		
First rib	1.28	0.15
Last rib	0.91	0.18
Last lumbar	1.04	0.18
Avg. fat	1.08	0.16
Days to market		
Days on test	108	9.83

TABLE III

PERFORMANCE OF PIGS BY BREED[a] (TRIAL I)

	Breed	
	Hampshire	Duroc
No. of animals	45	38
Avg. wt. and gain, lb.		
Initial wt.[b]	63	66
Final wt.[b]	224	222
Total gain[b]	161	157
ADG[b]	1.51	1.47
Backfat thickness, in.		
First rib[b]	1.26	1.31
Last rib[b]	0.89	0.92
Last lumbar[b]	1.02	1.06
Avg. fat[b]	1.06	1.09
Days to market		
Days on test[b]	107	107

[a]These values are least square means.

[b]Values in this row were not significantly different ($P > 0.05$).

gilts. Barrows gained 1.55 pounds per head per day compared to 1.42 pounds per head per day for the gilts. The total post-weaning gain of 161 pounds for the barrows was significantly ($P < 0.01$) greater than that of 155 pounds for the gilts. As shown in Table IV, the barrows were significantly ($P < 0.01$) fatter than the gilts at all probe sites and the barrows required significantly ($P < 0.05$) fewer days than the gilts to reach market weight. Barrows and gilts required 105 and 109 days, respectively to reach market weight. This is also in agreement with results reported by Hugh and Reimer (1967).

Results of the performance of the pigs by treatment are presented in Table V. There was no significant difference between the treatment (number of pigs per pen) means with respect to any of the traits measured. The pigs on treatment one were provided 23.8 square feet per pig, those on treatment two were provided 15.8 square feet per pig, those on treatment three were provided 11.9 square feet per pig, and those on treatment four were provided 9.5 square feet per pig. Noland et al. (1959) found that pigs provided 16 or 24 square feet gained faster than pigs provided 8 square feet which disagrees with this study. Burnside et al. (1969) found pigs gained significantly ($P < 0.05$) faster when allowed 0.55 square meters (5.78 square feet) as compared to 0.41 square meters (4.31 square feet) but no difference was found between 0.82 square meters (8.61 square feet) and 0.55 square meters (5.78 square feet) which is comparable to this study. This study is also in disagreement with Clawson (1962), who found gains were significantly affected when the floor space per pig was reduced from 21 square feet to 14 square feet and then to 10.5 square feet.

TABLE IV

PERFORMANCE OF PIGS BY SEX[a] (TRIAL I)

	Sex	
	Gilts	Barrows
No. of animals	44	39
Avg. wt. and gain, lb.		
Initial	67	63
Final	222	224
Total gain	115[b]	161[c]
ADG	1.42[b]	1.55[c]
Backfat thickness, in.		
First rib	1.22[b]	1.36[c]
Last rib	0.83[b]	0.98[c]
Last lumbar	0.96[b]	1.11[c]
Avg. fat	1.00[b]	1.15[c]
Days to market		
Days on test	109[b]	105[c]

[a]These are least square mean values.

[b,c]Means in the same rows superscripted with different letters are significantly different ($P < 0.05$).

TABLE V

PERFORMANCE OF PIGS BY TREATMENT[a] (TRIAL I)[b]

	Treatments			
	1	2	3	4
Avg. wt. and gain, lb.				
Initial	65	65	65	65
Final	225	223	223	221
Total gain	160	158	158	156
ADG	1.48[c]	1.52[c]	1.46[c]	1.48[c]
Backfat thickness, in.				
First rib	1.27[c]	1.27[c]	1.30[c]	1.30[c]
Last rib	0.82[c]	0.91[c]	0.92[c]	0.95[c]
Last lumbar	0.96[c]	1.04[c]	1.06[c]	1.08[c]
Avg. fat	1.02[c]	1.07[c]	1.09[c]	1.11[c]
Days to market				
Days on test	108[c]	104[c]	109[c]	107[c]
Feed requirements, lb.				
Total feed eer head	514[c]	482[c,d]	480[c,d]	467[d]
Feed per cwt. gain	321[c]	299[c]	307[c]	298[c]

[a]These values are least square means.

[b]Treatment 1 = 4 pigs per pen
2 = 6 pigs per pen
3 = 8 pigs per pen
4 = 10 pigs per pen

[c,d]Means in the same row superscripted with different letters are significantly different ($P < 0.05$).

Feed required per unit of gain was not significantly different among the treatments (Table V).

The performance of the pigs by replications or position in the barn is presented in the Appendix (Table XIV). Of the traits measured, none were found to be significant except the backfat thickness of 0.96 inches for the last rib of the group in the middle of the barn was significantly ($P < 0.05$) thicker than that at the last rib of the group at the south end (0.83 inches) or at the north end (0.92 inches).

In Trial I no significant difference between treatments (variation in floor space) was noted with respect to any of the traits measured. However, significant differences were observed between barrows and gilts. These differences due to sex were expected based on previous results.

II. TRIAL II

The overall means for the various traits which measured rate of gain and backfat thickness and their standard errors are presented in Table VI. A total of 56 market hogs were fed during Trial II for an average of 91 days. The overall average daily gain was slightly higher in Trial II than in Trial I, 1.60 pounds per head per day as compared to 1.48 pounds per head per day. This could possibly be a result of the season of the year. Trial I was conducted in the winter and Trial II was conducted in the summer. The average backfat thickness of 1.37 inches (Table VI) is more than the 1.08 inches (Table II, page 14) for Trial I. This could be because Trial II contains all Durocs and Trial I contained both Durocs and Hampshires.

TABLE VI

PERFORMANCE OF PIGS THAT WERE FED TOGETHER IN GROUPS OF 4, 6, 8, OR 10 IN THE SAME SIZE PEN (TRIAL II)

	Overall Means	Standard Error
Avg. wt. and gain, lb.		
Initial	78	9.77
Final	223	10.42
Total gain	145	9.84
ADG	1.60	0.16
Backfat thickness, in.		
First rib	1.79	0.25
Last rib	1.07	0.24
Last lumbar	1.25	0.20
Avg. fat	1.37	0.21
Days to market		
Days on test	91	6.76

The performance of the pigs with respect to various traits are shown by treatments in Table VII. There was no significant difference among the treatment means for the various measurements of growth and fatness. This is in agreement with the results of Trial I but in disagreement with the results reported by Burnside et al. (1969), Clawson (1962), and Noland et al. (1959).

The performance of the pigs by sex, as shown in Table VIII, for Trial II was very similar to that of Trial I. The barrows had a significantly higher ($P < 0.05$) average daily gain and total gain than the gilts. They were also significantly fatter ($P < 0.05$) than the gilts as was expected from the result of the first trial. Although the barrows reached market weight faster than the gilts, 89 and 92 days, respectively, the difference between these means were not significant ($P > 0.05$). This is in contrast to the results of Trial I. However, these differences in Trial II approached significance at the 5 per cent level of probability.

The group of pigs designated as the heavy replication were significantly heavier ($P < 0.01$) at the beginning of the test than the group designated as the light replication. However, the experiment was designed in this manner to prevent competition between pigs greatly different in weight. The light group made significantly more ($P < 0.05$) total gain than the heavy group, 152 and 144 pounds, respectively. Rate of gain, fat thickness and final weight were similar for the light and heavy groups (Table IX).

TABLE VII

PERFORMANCE OF PIGS BY TREATMENT[a] (TRIAL II)

	Treatments[b]			
	1	2	3	4
Avg. wt. and gain, lb.				
Initial	78	78	77	77
Final	226	224	227	223
Total gain	148	146	150	146
ADG	1.71	1.63	1.63	1.62
Backfat thickness, in.				
First rib	1.85	1.80	1.86	1.93
Last rib	1.15	1.07	1.06	1.18
Last lumbar	1.34	1.19	1.29	1.35
Avg. fat	1.45	1.36	1.40	1.49
Days to market				
Days on test	87	89	92	92
Feed requirements, lb.				
Total feed per head	468	468	478	472
Feed per cwt. gain	317	327	324	326

[a]These values are least square means.

[b]Treatment 1 = 4 pigs per pen
2 = 6 pigs per pen
3 = 8 pigs per pen
4 = 10 pigs per pen

TABLE VIII

PERFORMANCE OF PIGS BY SEX[a] (TRIAL II)

	Sex	
	Gilts	Barrows
No. of animals	46	10
Avg. wt. and gain, lb.		
Initial	78	76
Final	222	228
Total gain	144[b]	152[c]
ADG	1.58[b]	1.71[c]
Backfat thickness, in.		
First rib	1.72[b]	1.99[c]
Last rib	1.04[b]	1.19[c]
Last lumbar	1.22[b]	1.37[c]
Avg. fat	1.33[b]	1.52[c]
Days to market		
Days on test	92[b]	89[b]

[a]These values are least square means.

[b,c]Means in the same row superscripted with different letters are significantly different ($P < 0.05$).

TABLE IX

PERFORMANCE OF PIGS BY INITIAL WEIGHT GROUPS[a] (TRIAL II)

	Initial Weight Groups[b]	
	Light	Heavy
Avg. wt. and gain, lb.		
Initial	70[c]	84[d]
Final	222[c]	227[c]
Total gain	152[c]	144[d]
ADG	1.65[c]	1.64[c]
Backfat thickness, in		
First rib	1.86[c]	1.86[c]
Last rib	1.20[c]	1.04[c]
Last lumbar	1.35[c]	1.24[c]
Avg. fat	1.47[c]	1.38[c]
Days to market		
Days on test	92	88
Feed requirements, lb.		
Total feed per head	475	470
Feed per cwt. gain	317	329

[a]These values are least square means.

[b]There was one light weight and one heavy weight group on each treatment with a total of 28 pigs in each weight group.

[c,d]Means in the same row superscripted with the same letter are not significantly different ($P < 0.05$).

Performance of the pigs by treatment in Trial II was not significantly different as was the results of Trial I. There was a significant difference in the performance of the pigs by sex and by weight groups; however, the overall results of Trial II were similar to that of Trial I.

CHAPTER V

SUMMARY

Data collected on 140 market hogs at the Knoxville Experiment Station, Knoxville, Tennessee, were used to determine the effect of the number of pigs per pen on performance of growing-finishing swine. In Trial I pigs were fed for an average of 108 days and in Trial II pigs were fed for an average of 91 days. In both trials pigs were fed in groups of 4, 6, 8, or 10 pigs per pen with space allowances of 23.8 square feet, 15.8 square feet, 11.9 square feet, or 9.5 square feet per pig, respectively.

Average daily gains in Trial I were 1.48, 1.52, 1.46, and 1.48 pounds per head per day for Treatments I, II, III, and IV, respectively. No significant difference between treatments (variation in floor space) was noted with respect to any traits measured (Trial I). However, significant ($P < 0.05$) differences were observed between barrows and gilts.

In Trial II average daily gains were 1.71, 1.63, 1.63, and 1.62 pounds per head per day for Treatments I, II, III, and IV, respectively. Performance of the pigs by treatment in Trial II was not significantly different as was the results of Trial I. There was a significant ($P < 0.05$) difference in the performance of the pigs by sex and by weight groups; however, the overall results of Trial II were similar to that of Trial I.

LITERATURE CITED

LITERATURE CITED

Bond, T. E. and G. M. Petersen. 1958. Hog houses. USDA Misc. Pub. 744. pp. 1-14.

Burnside, J. E., E. Covey and A. Reed. 1969. Air conditioned vs. conventional housing for growing-finishing swine. J. Animal Sci. 28:140. Abstr.

Clawson, A. J. 1962. Effect of number of pigs per pen of equal floor space on performance. J. Animal Sci. 21(2):382. Abstr.

Corrick, J. A. 1968. Growth and reproduction of albino rats as affected by various excessive levels of dietary vitamin E. Ph.D. dissertation. Univ. of Tennessee.

Gehlbach, G. D., D. E. Becker, J. L. Cox, B. G. Harmon, A. H. Jensen. 1966. Effects of floor space allowance and number per group on performance of growing-finishing swine. J. Animal Sci. 25:386-391.

Harvey, Walter R. 1960. Least square analysis of data with unequal subclass numbers. U.S.D.A.-A.R.S. 20-8.

Hietman, Hubert, Jr., LeRoy Hahn, C. F. Kelley and T. E. Bond. 1961. Space allotment and performance of growing-finishing swine raised in confinement. J. Animal Sci. 20:543-546.

Hugh, W. I. and D. Reimer. 1967. Floor space allotment for growing-finishing pigs. J. Animal Sci. 26:891. Abstr.

Kramer, C. Y. 1957. Extension of multiple range test to group correlated adjusted means. Biometrics 13:13.

Midwest Plan Service. 1968. Swine housing and equipment handbook. MWPS-8. pp. 1-13.

Muehling, A. J. 1969. Confinement swine housing-space requirements. Univ. Ill. Agr. Engin. Dept. pp. 1-2.

National Hog Farmer. 1969. Swine Information Service-Management Recommendations. No. A1. pp. 1-3.

Holand, P. R., K. W. Scott and C. A. Buagus. 1959. Space needs and feeder arrangement in confinement feeding of pigs. Ark. Farm. Res. 8(2):8.

Rea, J. C. 1970. Performance of market hogs fed to various weights. Seminar for Pork Producers and Packers. Univ. of Missouri-Columbia, 9:4. pp. 1-4.

Steel, R. G. D. and J. H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., New York.

APPENDIX

TABLE X

ANALYSIS OF VARIANCE FOR VARIOUS TRAITS (TRIAL I)

		Mean Square								
Source	DF	Initial wt.	Final wt.	Fat First rib	Fat Last rib	Fat Last lumbar	Avg. fat	Days on test	ADG	Total Gain
Treatment[a]	3	2.11	34.25	0.01	0.04	0.04	0.02	86.19	0.01	24.29
Sex[b]	1	291.61	118.02	0.33**	0.36**	0.40**	0.36**	407.02*	0.30**	780.66*
Breed[c]	1	171.67	39.18	0.04	0.01	0.02	0.02	2.56	0.02	374.86
Rep[c]	2	14.14	30.12	0.01	0.11*	0.07	0.05	89.75	0.02	15.98
Br. x Sex	1	246.49	203.73	0.02	0.01	0.01	0.01	61.17	0.01	2.04
Br. x Tmt.	3	25.80	31.51	0.02	0.03	0.13**	0.02	17.32	0.02	108.11
Br. x Rep	2	52.24	139.93	0.01	0.04	0.01	0.01	80.55	0.02	21.38
Sex x Tmt.	3	184.09	88.43	0.21**	0.01	0.00	0.01	106.07	0.01	31.97
Sex x Rep	2	91.88	9.59	0.01	0.03	0.02	0.01	49.04	0.00	58.41
Tmt. x Rep	6	4.75	32.12	0.00	0.02	0.02	0.01	76.03	0.02	49.61
Residual	58	178.29	84.82	0.02	0.03	0.03	0.02	96.98	0.02	167.98

[a]4, 6, 8, and 10 pigs per pen.

[b]Hampshire and Duroc gilts and Hampshire and Duroc barrows.

[c]Hampshire and Duroc.

[d]Position in barn.

*Significant at 0.05 level.

**Significant at 0.01 level.

TABLE XI

ANALYSIS OF VARIANCE FOR VARIOUS TRAITS (TRIAL II)

		Mean Square								
Source	DF	Initial wt.	Final wt.	Fat First rib	Fat Last rib	Fat Last lumbar	Avg. fat	Days on test	ADG	Total Gain
Treatment[a]	3	12.92	25.54	0.03	0.03	0.04	0.03	40.44	0.01	43.38
Sex[b]	1	24.44	295.33	0.56**	0.17	0.16	0.26*	53.22	0.12*	384.73*
Rep[c]	1	1382.07**	205.69	0.00	0.19	0.09	0.06	130.27	0.00	468.59*
Sex x Tmt.	3	14.84	4.69	0.05	0.02	0.05	0.04	51.62	0.01	18.69
Sex x Rep	1	45.24	0.93	0.09	0.09	0.09	0.10	14.82	0.00	15.22
Tmt. x Rep	3	6.68	190.25	0.08	0.04	0.07	0.07	96.43**	0.08	221.81*
Residual	43	41.82	102.83	0.05	0.06	0.04	0.04	32.73	0.02	67.21

[a]4, 6, 8, and 10 pigs per pen.

[b]Duroc gilts and barrows.

[c]Light and heavy groups.

*Significant at 0.05 level.

**Significant at 0.01 level.

TABLE XII

CORRELATIONS AMONG VARIOUS TRAITS (TRIAL I)

Traits	Initial wt.	Final wt.	Fat First Rib	Fat Last Rib	Fat Last Lumbar	Avg. Fat	Days on Test	ADG	Total Gain
Initial wt.	1.00	0.39	-.09	-.22	-.12	-.15	-.69	-.00	0.76
Final wt.		1.00	0.33	0.17	0.21	0.25	0.49	0.70	0.31
Fat first rib			1.00	0.72	0.78	0.88	-.07	0.31	0.33
Fat last rib				1.00	0.94	0.95	0.13	0.15	0.35
Fat last lumbar					1.00	0.98	0.04	0.17	0.27
Avg. fat						1.00	0.04	0.22	0.33
Days on test							1.00	-.62	0.36
ADG								1.00	0.50
Total gain									1.00

TABLE XIII

CORRELATIONS AMONG VARIOUS TRAITS (TRIAL II)

Traits	Initial wt.	Final wt.	Fat First Rib	Fat Last	Fat Last Lumbar	Avg. Fat	Days on Test	ADG	Total Gain
Initial wt.	1.00	0.61	0.13	0.02	0.15	0.12	-.55	0.43	0.05
Final wt.		1.00	0.42	0.21	0.43	0.39	-.43	0.76	0.76
Fat first rib			1.00	0.60	0.77	0.88	-.47	0.58	0.40
Fat last rib				1.00	0.65	0.85	-.08	0.24	0.31
Fat last lumbar					1.00	0.89	-.33	0.45	0.36
Avg. fat						1.00	-.31	0.45	0.39
Days on test							1.00	-.81	-.13
ADG								1.00	0.68
Total gain									1.00

TABLE XIV

PERFORMANCE OF PIGS BY POSITION IN BARN[a] (TRIAL I)[b]

	Position in Barn		
	South End	Middle	North End
Avg. wt. and gain, lb.			
Initial	65	64	65
Final	223	222	224
Total gain	158	158	159
ADG	1.50	1.45	1.51
Backfat thickness, in.			
First rib	1.26	1.30	1.30
Last rib	0.83	0.96*	0.92
Last lumbar	0.97	1.08	1.06
Avg. fat	1.02	1.11	1.09
Days to market			
Days on test	106	109	106
Feed requirement, lb.			
Total feed per head	475	480	487
Feed per cwt. gain	301	312	305

[a]These values are least square means.

[b]Each of the four treatments were in each of the three positions in the barn.

*Significant at the 0.05 level.

VITA

John Hodges III was born in Clarksville, Tennessee, on January 14, 1948. He was reared in Dickson County, Tennessee and graduated from Charlotte High School in May, 1966. He enrolled at The University of Tennessee in September, 1966, and received the B. S. degree from that institution in June, 1970. Following graduation he entered the Graduate School of The University of Tennessee serving as an Assistant in Animal Husbandry and Herdsman at U.T. Blount Farm. He received the M. S. degree in Animal Husbandry in June, 1972.